

Docket No. 396.43046X00
Serial No. 10/654,997
August 15, 2005

REMARKS

Applicants have amended their claims in order to further clarify the definition of various aspects of the present invention. Specifically, Applicants have cancelled claim 1, the sole independent claim presently in the application, and have substituted therefor new claim 13. Claim 13 recites a cleaning composition adapted for removing photoresists from a substrate, including specific amounts of (a) N-hydroxyformamide of a specified formula, (b) an alkaline compound and (c) an organic solvent. In light of canceling of claim 1 and substitution therefor of claim 13, dependencies of various of the previously considered claims have been amended, and claim 2 has been cancelled without prejudice or disclaimer. In addition, a typographical error in claim 9 has been corrected.

Moreover, Applicants are adding new claims 14-18 to the application. Claim 14, dependent on claim 13, recites that the composition consists essentially of the components in the recited amounts set forth in claim 13. Claims 15, 16 and 18, dependent respectively on claims 13, 15 and 16, further define amounts of alkaline compound, organic solvent and water, respectively contained in the cleaning composition. Claim 17, dependent on claim 16, recites that the organic solvent is a water-soluble organic solvent.

In connection with amendments to the original claims, and in connection with the new claims, note, for example, pages 3-9 of Applicants' specification.

In response to the requirement in the first paragraph on page 3 of the Office Action mailed February 14, 2005, Applicants respectfully affirm their election of the Group I claims, claims 1-11, directed to the cleaning composition.

Docket No. 396.43046X00
Serial No. 10/654,997
August 15, 2005

Applicants respectfully traverse the rejection of their claims under the first paragraph of 35 USC 112, particularly insofar as this rejection applicable to the claims as presently amended. Thus, claim 13, the sole independent claim in the application, recites that the cleaning composition includes a specific amount of N-hydroxyformamide represented by a specific formula, the specific formula being that set forth at page 3, line 11, of Applicants' specification. Note that the Examiner has indicated that Applicants' specification is enabling for the specific compound "N-hydroxyformamide". See the last paragraph on page 3 of the Office Action mailed February 14, 2005. In light of newly submitted claim 13, it is respectfully submitted that the rejection under the first paragraph of 35 USC 112 is moot.

Applicants respectfully submit that all of the claims presented for consideration by the Examiner patentably distinguish over the teachings of the references applied by the Examiner in rejecting claims in the Office Action mailed February 14, 2005, that is, the teachings of U.S. Patent No. 6,037,472 to Castelhana, et al., of the published U.S. Patent applications to Carter, et al., No. U.S. 2004/0152309 and to Miller, et al., No. U.S. 2002/0177316, and International (PCT) Publication No. WO 99/23667, under the provisions of 35 USC 102 and 35 USC 103.

It is respectfully submitted that these references as applied by the Examiner would have neither taught nor would have suggested such a cleaning composition as in the present claims, adapted for removing photoresists from a substrate, including specified amounts of N-hydroxyformamide and optionally of an alkaline compound and an organic solvent. See claim 13.

Moreover, it is respectfully submitted that these references would have neither disclosed nor would have suggested such cleaning composition as in the present

Docket No. 396.43046X00
Serial No. 10/654,997
August 15, 2005

claims, adapted for removing photoresists from a substrate, consisting essentially of the recited amounts of the N-hydroxyformamide, alkaline compound and organic solvent. See claim 14.

Moreover, it is respectfully submitted that the references as applied by the Examiner would have neither taught nor would have suggested such cleaning composition as in the present claims, adapted for removing photoresists from a substrate, the cleaning composition including the alkaline compound (note claims 3 and 16), and/or the organic solvent (see claims 6 and 17), and/or water (see claims 11 and 19), especially in specified amounts as in the present claims.

In addition, it is respectfully submitted that the teachings of these applied references would have neither disclosed nor would have suggested such a cleaning composition as in the present claims, having features as discussed previously in connection with claim 13, and, moreover, wherein the cleaning composition further includes a corrosion inhibitor (see claim 7), or an amine polymer having an average molecular weight of 250 or more (see claim 8), particularly wherein the amine polymer is at least one polymer selected from the group set forth in claim 9, or further comprises a compound having a hydroxymethylamino structure as in claim 10.

Furthermore, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such a cleaning composition as in the present claims, including the specified alkaline compound, and wherein the alkaline compound is free from metallic element (see claim 4), or wherein the alkaline compound is selected from the compounds set forth in claim 3; and/or wherein the organic solvent is a water-soluble organic solvent (see claim 18).

Docket No. 396.43046X00
Serial No. 10/654,997
August 15, 2005

In any event, even assuming, arguendo, that the applied references would have established a prima facie case of obviousness, the evidence in Applicants' specification (Examples and Comparative Examples on pages 12-18 thereof) shows unexpectedly better results in improved resist removal without corrosion, achieved by compositions within the scope of the present claims, and clearly overcomes any such prima facie case and establishes unobviousness of the presently claimed invention.

That is, as shown infra, the anticipation rejection is clearly improper, and the Examiner has not established a prima facie case of obviousness. However, even if the Examiner has established such prima facie case, the evidence of record clearly rebuts such prima facie case.

Thus, as seen in Table 1 on page 13 of Applicants' specification, compositions within the scope of the present claims either completely or substantially completely remove resist residue, while compositions including N-hydroxyacetamide, N,N-diethylhydroxylamine or hydroxylamine but without N-hydroxylformamide do not remove the resist or corrode the resulting substrate. See also Tables 2, 3 and 4 on pages 14-18 of Applicants' specification. These Tables 1-4 show unexpectedly better results in resist removal, while avoiding corrosion, of cleaning compositions within the scope of the present claims, which include N-hydroxyformamide in amounts as in the present claims, as compared with other compositions outside the scope of the present claims (e.g., without N-hydroxyformamide, but with another nitrogen-containing compound), and clearly supports a conclusion of unobviousness.

The present invention is directed to a cleaning composition for removing photoresists from substrates, photoresists being widely used in lithographic

Docket No. 396.43046X00
Serial No. 10/654,997
August 15, 2005

production of various devices such as integrated circuits, display devices, printed boards, micromachines, DNA chips, microplants, etc.

Alkaline cleaning compositions, such as a composition including an alkanol amine and an organic solvent, and a composition including a quaternary ammonium hydroxide and an organic solvent, have been conventionally used to remove photoresists. However, as semiconductor devices and other devices require finer processing and shorter-term treatment, the need continues for more efficient cleaning compositions. In addition, the conventional cleaning compositions are unsatisfactory in removing resist residue, which are probably made of inorganic substances, such as side wall polymers formed on substrates through a dry etching process and subsequent ashing process. Furthermore, a need exists for providing such cleaning composition which is efficient and effective in removing resist residues in a short time, while avoiding corrosion of materials remaining on the substrate, such as wiring layers.

Against this background, Applicants provide a cleaning composition which can effectively remove photoresists, including resist residues on side walls, in a short time, and without corrosion of remaining structures. Applicants have found that by incorporating N-hydroxyformamide of the formula (2) on page 3 of Applicants' specification, in amounts as set forth in the present claims, a cleaning composition which is effective for removing photoresists including resist residues on side walls, in a short time and without corrosion of underlying structure, is achieved. Such cleaning composition is even more effective when including an alkaline compound and/or an organic solvent, and is still more effective upon utilizing other components as set forth in the present claims. Note, for example, page 3, lines 17-19; page 8, lines 5-11; and page 9, lines 12-15, of Applicants' specification.

Docket No. 396.43046X00
Serial No. 10/654,997
August 15, 2005

Note also page 11, lines 3-12, of Applicants' specification, describing a way that the N-hydroxyformamide can possibly operate in order to effectively remove resist.

Castelhana, et al. discloses compounds and their pharmaceutically acceptable salts, which inhibit matrix metalloproteases, and are effective in treating disease-states characterized by excessive activity of matrix metalloproteases. The compounds are described most generally from column 2, line 39, through column 3, line 10 of this patent, and include compounds where R¹ is N-hydroxyformamide.

It is respectfully submitted that this patent does not disclose, nor would have suggested, a cleaning composition, adapted for removing photoresists from a substrate, including a specific amount of N-hydroxyformamide represented by the formula (2) as in the present claims, or advantages thereof in removal of photoresists, or other aspects of the present invention as discussed in the foregoing. Note that the compounds in Castelhana, et al. are relatively complex materials containing a N-hydroxyformamide group for R¹, and would have neither disclosed nor would have suggested the compound represented by the formula (2) as in claim 13, or other features of the present invention as in the present claims.

WO 99/23667 discloses nuclear fuel processing, particularly for separation of uranium, plutonium and neptunium, the processing method being adapted to reduce Pu to Pu(III) and Np to Np(IV), the method including a first step of treating a mixture, containing Pu and Np, and optionally U, with hydroxylamine; and a second step of treating the mixture resulting from the first step with U(IV). Note page 2, lines 8-12. This patent further discloses, in a fifth aspect, a Purex reprocessing plant in which a conduit is provided between the aqueous product outlet of a Np rejection operation and the U/Pu split apparatus to enable a fraction of the Np rejection aqueous stream

Docket No. 396.43046X00
Serial No. 10/654,997
August 15, 2005

to be recycled to the split operation, and that this conduit normally includes a vessel to allow formohydroxamic acid hydrolysis to go to completion and so produce hydroxylamine to be used in the U/Pu split. Note page 3, lines 24-32 of WO 99/23667.

It is respectfully submitted that WO 99/23667 describes a nuclear fuel reprocessing method. The formohydroxamic acid is used to produce hydroxylamine used in the spent fuel processing. It is respectfully submitted that this patent does not disclose, nor would have suggested, a cleaning composition adapted for removing photoresists from a substrate, including specific amounts of the N-hydroxyformamide, especially in combination with other materials as set forth in various of the present claims.

Carter, et al. discloses a method of polishing a silicon-containing dielectric substrate, and a composition used in such method. The composition, a chemical-mechanical polishing composition, includes (a) ceria abrasive having an average particle size of about 150 nm or less; (b) a polishing additive bearing a functional group with a PK_a of about 4 to about 9, the polishing additive being a compound selected from a specific group thereof; and (c) a liquid carrier, the composition having a pH of about 3 to about 6. See paragraph [0008] bridging pages 1 and 2 of this patent document. Note also paragraph [0024] on page 4 of this patent document, disclosing various hydroxamic acids that can be used, including formohydroxamic acid.

It is emphasized that Carter, et al. discloses a chemical-mechanical polishing composition including, inter alia, an inorganic abrasive. It is respectfully submitted that this patent publication does not disclose, nor would have suggested, a cleaning composition as in the present claims, adapted for removing photoresists from a

Docket No. 396.43046X00
Serial No. 10/654,997
August 15, 2005

substrate. Clearly, inclusion of an inorganic abrasive in the composition of Carter, et al. would have taught away from a composition which is a cleaning composition, adapted for removing photoresists from a substrate.

In addition, and again emphasizing that Carter, et al. discloses a chemical-mechanical polishing composition requiring specified amounts of inorganic abrasive, it is respectfully submitted that this reference would have neither disclosed nor would have suggested the cleaning composition as in the present claims, including specified amounts of N-hydroxyformamide, and, more specifically, the additional materials included in the composition as in the present claims, including amounts thereof.

It is respectfully submitted that the additional teachings of Miller, et al. would not have rectified the deficiencies of Carter, et al., such that the presently claimed invention as a whole would have been obvious to one of ordinary skill in the art.

Miller, et al. discloses methods and chemistries for providing increased metal polish rates in chemical mechanical polishing. As described in paragraph [0021] on page 2 of this patent document, a copper polish slurry is disclosed, formed by combining a chelating, organic acid buffer system such as citric acid and potassium citrate, and an abrasive, such as for example colloidal silica, and an oxidizer, such as hydrogen peroxide. This patent document discloses that alternative copper polish slurries may be formed by further combining a corrosion inhibitor such as benzotriazole.

It is noted that Miller, et al. discloses a slurry for chemical mechanical polishing. However, in contrast to Carter, et al. and while Carter, et al. discloses a composition for polishing a silicon-containing dielectric, Miller, et al. discloses a slurry for polishing of copper. It is respectfully submitted that one of ordinary skill in

Docket No. 396.43046X00
Serial No. 10/654,997
August 15, 2005

the art concerned with in Carter, et al., directed to polishing a silicon-containing dielectric, would not have looked to the teachings of Miller, et al., directed to polishing of copper.

In any event, even assuming, arguendo, that the teachings of Carter, et al. and of Miller, et al. were properly combinable, such combined teachings would have neither disclosed nor would have suggested the presently claimed cleaning composition, adapted for cleaning photoresist from a substrate, and including specific amounts of N-hydroxyformamide as in the present claims, more specifically, including the N-hydroxyformamide and other components, in specified amounts, as in various of the present claims.

The contention by the Examiner in the paragraph bridging pages 6 and 7 of the Office Action mailed February 14, 2005, that it would have been obvious from the teachings of Carter, et al. "to formulate a cleaning composition" containing specified components in the specific proportions as recited in the present claims, "with a reasonable expectation of success and similar results with respect to other disclosed components, because the broad teaching of Carter et al suggest a cleaning composition containing [the components in the specific proportions] as recited in the instant claims" is respectfully traversed, particularly insofar as applicable to the claims as presently amended. It is emphasized again that Carter, et al. is directed to a chemical-mechanical polishing composition, not a cleaning composition. Taking the teachings of Carter, et al. as a whole, as required under 35 USC 103, it is respectfully submitted that Carter, et al. would have neither taught nor would have suggested a cleaning composition, much less a cleaning composition adapted for removing photoresists from a substrate, and including components in amounts as recited in the present claims. Absent hindsight use of Applicants' disclosure, which

Docket No. 396.43046X00
Serial No. 10/654,997
August 15, 2005

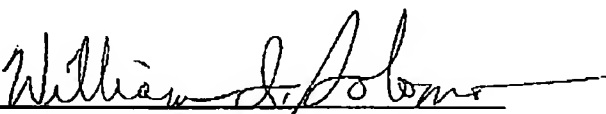
of course is improper under the requirements of 35 USC 103, it is respectfully submitted that the Examiner has set forth no basis for the chemical-mechanical polishing composition of Carter, et al. being a cleaning composition, much less a cleaning composition adapted for removing photoresists from a substrate.

In view of the foregoing comments and amendments, reconsideration and allowance of all claims remaining in the application are respectfully requested.

Applicants request any shortage of fees due in connection with the filing of this paper be charged to the Deposit Account of Antonelli, Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (case 396.43046X00), and credit any excess payment of fees to such Deposit Account.

Respectfully submitted,

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